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Wage Formation and Monetary
Policy Rules

by

Norbert Funke

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Wage Formation and Monetary Policy Rules

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Abstract*

This paper characterizes the wage setting behavior in a totally unionized economy under different monetary policy rules. The wage formation strategy of the union can be either aggressive or cooperative. As long as the union is fully cooperative and in the absence of shocks, the government can completely reach its macro-economic targets: full employment and price stability. If, however, the union becomes aggressive, a constant money supply rule has a nominal wage inflation bias under certain plausible assumptions. By changing the rules of the game, e.g. following a nominal GNP or price level (inflation) rule, wage demands would be lower and the economy better off.

1. Introduction

It is well-known, by now, that discretionary or short-sighted¹ monetary policy can have an inflationary bias. In the presence of distortions or market imperfections, authorities may be tempted to inflate surprisingly in order to raise output beyond the natural rate [Kydland and Prescott, 1977; Barro and Gordon, 1983a]. Although this surprise effect may work once or twice, the private sector, in general, is aware that the incentive of the authorities is "to cheat" and forms expectations accordingly. In the resulting Nash equilibrium, real income equals the natural rate, but the economy bears the cost of a higher inflation than is socially desired and optimal. Authorities can improve the outcome by committing themselves to low inflation.

* I thank Peter Nunnenkamp, Rainer Schweickert and Joachim Scheide for valuable comments on an earlier draft. The usual disclaimer applies.

¹ For the use of terminology see Blanchard and Fischer, 1989, p. 595.

By identifying the precommitted solution with a rule, Kydland and Prescott [1977] established a much stronger case for rules than the pre-1977 arguments. The earlier case for rules was, to a large extent, vulnerable to the criticism that the outcome of any rule could also be reached by discretion.¹ Nevertheless, the case is not for a simple constant money growth rate à la Friedman per se. On the one hand, the potential benefits of discretion may not be ignored, but on the other hand, a number of alternative nominal anchors have been proposed during the last 15 years, including a nominal income rule, price rules or even the international coordination of rules.²

To compare theoretically various monetary policy rules, their capacity to absorb unpredictable shocks - demand or supply, real or monetary, temporary or permanent, and country-specific or world-wide - plays a central role [e.g. Fukuda and Hamada, 1988; Frankel and Chinn, 1991]. In fact, Rogoff [1985, p. 1186] stresses that if the analysis is restricted to rigid targeting regimes, where policy-makers are able to make binding commitments and to hit their targets accurately, the ranking of alternative nominal anchors depends crucially on these conventional stabilization properties.

In these standard frameworks, however, aggregate supply (employment) depends on the discrepancy between the actual and the expected price level (inflation rate). This "Phillips curve" type of relationship can be justified by assuming price rigidities, e.g. nominal wages for period t (w_t) are set at the end of period $t-1$ before shocks are revealed [Gray, 1976]. The crucial issue that remains is what assumption to make with regard to wage setting (price expectations). The usual explicit or implicit assumption is that with a precommitted authority to a zero infla-

¹ A recent survey of the rules versus discretion debate is e.g. given by Fischer [1988].

² Empirical analyses/simulations are rare. Examples include McCallum [1987], Scheide [1989], Frankel [1991].

tion target and in the absence of shocks, wage agreements are compatible with price stability and full employment.¹ This wage setting behavior can be called "cooperative". By way of contrast, unions sometimes apparently try to increase real wage above the full employment real wage. This wage formation behavior can be called aggressive.

The principal difference between this paper and previous monetary stabilization analyses derives from alternative specifications of the union's loss function. In particular, it is distinguished between cooperative and aggressive unions. The basic hypothesis is that the optimal monetary policy rule depends on the wage negotiation behavior of labor unions and vice versa, that the choice of a specific monetary rule influences the wage formation process.

The analysis proceeds in three steps. Part 2 describes the interaction between unions and central banks as a two-player game. Part 3 lays down the basic model, where wages are fixed before demand and supply shocks are revealed, and illustrates the nominal wage inflation bias of a constant money supply rule when union wage negotiation behavior becomes aggressive. The outcome of a constant money supply rule is compared to the outcome when authorities target either nominal income or the price level (inflation rate). Part 4 illustrates the importance of the union's objective function for the appropriate choice of a monetary policy rule by altering the union's loss function used in Part 3. Finally, Part 5 provides a summary of the main conclusions.

¹ According to this wage setting behavior, wages are fixed at the expected price level for period t based on $t-1$ information [$\bar{w}_t = E_{t-1} p_t$]. Rogoff [1985] explicitly derives this relation along with the standard aggregate supply equation, from a Cobb-Douglas production function and competitive profit maximizing firms.

2. Unions and Central Banks: A Game Between Two Players

In reality, both central banks and unions are complex organizations that follow their own internal dynamics to a certain extent. However, for our purposes, it may be an appropriate simplification to think of each organization as a player, that has two possible strategies [see e.g. von Weizsäcker, 1978]. The bargaining strategy of the union can be cooperative or aggressive; the policy of the monetary authority can be either expansionary or restrictive. The objective functions of the labor union and the central bank differ. If price stability is the major objective of the monetary authority, monetary policy tends to be restrictive, independent of the union's bargaining strategy. If higher real wage is the major objective of the union, its bargaining strategy tends to be aggressive,¹ independent of the strategy of the monetary authority. The final outcome of the game is a relatively restrictive monetary policy and a relatively aggressive union wage policy, which tend to reduce employment and increase inflation. This result represents a non-cooperative equilibrium. Both the monetary authority and the union might prefer the outcome of a situation where monetary policy is slightly less restrictive and the union more cooperative.

Due to the complexity of the game in reality a cooperative solution is rather unlikely. However, a more satisfactory result of the game might be possible if the rules of the game are changed.² The effects of alternative rules will be analyzed subsequently.

¹ Recent German wage agreements (on average above 5 per cent) at a time of slowing real growth in the West might be interpreted as an example of aggressive labor union behavior.

² In connection with his verbal description of this prisoner's dilemma kind of structure, von Weizsäcker [1978] was, besides Meade [1978], one of the first economists to propose targeting nominal income instead of money supply.

3. The Basic Model

The single-period loss function of the union is quadratic in the deviation of real wage, $[\bar{w}_t - p_t]$, from a target level, and in the deviation of output from the natural rate, y_t :¹

$$[1] \quad L_t^u = \beta [\bar{w}_t - p_t - \alpha]^2 + y_t^2,$$

where β is the weight assigned to the real wage objective. Throughout, subscript t denotes time and lower case letters denote natural logarithms. A bar indicates that nominal wages (\bar{w}_t) are set in advance. Furthermore, all variables are expressed in deviations from their equilibrium levels. The target level of real wage exceeds the full employment real wage by α [Tabellini, 1988].² The assumption that $\alpha > 0$ is crucial. A plausible justification comes from political economy. Unions are not necessarily concerned to the same degree with employed and unemployed union members and their respective incomes. For a given α ($\alpha > 0$), a union is considered as aggressive if $\beta > 0$. If $\beta = 0$, the union is fully cooperative and the achievement of the authority's final targets, full employment and price stability, is not jeopardized from the beginning.³ The loss function of the authority (social

¹ To simplify algebra without loss of generality, the loss function is assumed to be quadratic [see e.g. Blanchard and Fischer, 1989; Frankel and Chinn, 1991] and real economic activity is taken as a convenient proxy for employment.

² In contrast to Tabellini [1988, p. 104] the quadratic function of output is added to the loss function [1]. Dropping this term would change the expected losses of the union and artificially favor a price rule from the union's perspective. An overview of alternative trade union objective functions and the main criticisms of the widely adopted method of treating unions as profit maximizers or, equivalently, as loss minimizers is given by Chapman [1986].

³ A recent game theoretical model (without the distinction between a cooperative and aggressive union), where the union wants to maximize its "expected" real wage bill, is presented by Bieta and Straub [1991].

loss function), which is used to assess the effects of alternative monetary rules, simply is¹

$$[2] \quad L_t^A = \Phi p_t^2 + Y_t^2.$$

where $\Phi > 0$ is the authority's weight assigned to price stability.

Wages are negotiated at the end of period $t-1$ for period t and workers agree to supply whatever amount of labor is demanded by firms at the negotiated wage rate. Therefore, in period t employment is completely determined by demand [Gray, 1976]. Furthermore, it is assumed that the union is strong, in the sense that the final negotiated wage rate (\bar{w}_t) is identical to the union's preferred nominal wage rate. This may be interpreted either as pure wage setting or as an assumption that the union's weapons (e.g. strikes) and its bargaining tactics are sufficient to ultimately reach the desired outcome.

Because of the type of wage contract, aggregate supply [3] depends on the discrepancy between the actual price level and the negotiated wage rate, as well as on a transitory aggregate supply disturbance u with $u \sim N(0, \sigma_u^2)$.

$$[3] \quad Y_t = \delta (p_t - \bar{w}_t) + u_t \quad \text{with } \delta > 0.$$

Substituting [3] in [1] the loss function of the union is:

$$[4] \quad L_t^u = \beta [\bar{w}_t - p_t - \alpha]^2 + [\delta(p_t - \bar{w}_t) + u_t]^2$$

¹ Assuming that the economy was in the cooperative equilibrium in $t-1$, the authority's price level target is equivalent here to a zero inflation target. Contrary to common practice in dynamic inconsistency models, it is not necessary to build in an "additional" inflationary bias in the authority's loss function [e.g. Blanchard and Fischer, 1989; Frankel and Chinn, 1991], because this is already implicitly done by the choice of the union's loss function if $\beta > 0$ (along with a given $\alpha > 0$).

Constant Money Supply Rule

The authority announces that it will follow a constant money supply rule. Although it is no easy task to impose an external mechanism that effectively ties the hands of the policy-maker, it is assumed that this precommitment is credible and irrevocable. Credibility could e.g. be supported by effectively indexing the annual salaries of central bankers to their success in hitting the targets [e.g. Neumann, 1991] or by introducing an appropriate law. Under a constant money rule the aggregate demand equation may be described by [see e.g. Dornbusch and Frankel, 1987]

$$[5] Y_t = \tau (m_t - p_t) + v_t$$

where v is a transitory demand shock, $v \sim N(0, \sigma_v^2)$, which e.g. may be interpreted as a disturbance in the public's demand for money or as a shift in intertemporal consumption preferences. The disturbances v and u are assumed to be independent and serially uncorrelated.

The union sets the wage so as to minimize its expected loss from [4] under the condition that the authority follows a constant money rule [5] with $m_t = 0$. Since $E_{t-1}u_t = E_{t-1}v_t = 0$ wage demands are not influenced by shocks. Therefore, the expected loss of the union is minimized if the wage is negotiated at ¹

$$[6a] \bar{w}_t^M = \frac{\alpha\beta(\delta+\tau)}{\tau(\beta+\delta^2)},$$

where superscript M denotes wage under money supply targeting. The more aggressive unions are (larger β) or the smaller the absolute value of the price elasticity of aggregate demand (τ) the higher nominal wage settings. Given \bar{w}_t^M , using [3] and [5], the resulting price level, real wage and output are

¹ The second-order conditions for a minimum are met. Given the quadratic form of the loss function, the minimum is global.

$$[6b] \quad p_t^M = \frac{\alpha\beta\delta}{\tau(\beta+\delta^2)} + \frac{1}{\delta+\tau} [v_t - u_t]$$

$$[6c] \quad \bar{w}_t^M - p_t^M = \frac{\alpha\beta}{\beta+\delta^2} + \frac{1}{\delta+\tau} [u_t - v_t]$$

$$[6d] \quad Y_t^M = \frac{-\alpha\beta\delta}{\beta+\delta^2} + \frac{1}{\delta+\tau} [\delta v_t + \tau u_t]$$

The result indicates that under a constant money supply rule the authority's target, full employment and price stability, can only be reached as long as the union is fully cooperative ($\beta = 0$) and there are no shocks ($u_t = v_t = 0$). Under these circumstances, both the union's and the authority's loss function are minimized ($L_t^u = L_t^A = 0$). However, if the union is aggressive the authority can no longer reach its targets. In the absence of shocks, inflation (the price level) is higher than socially desired and real income below the natural rate. This outcome, however, reflects the preference of the union exactly.

Nominal Income Rule

Now the outcome will be compared to the case where the monetary authority follows a nominal income rule¹ and is supposed to be able to target nominal income accurately, which implies that

$$[7] \quad Y_t + p_t = c,$$

where c denotes the policy determined level of nominal income. Assuming that the authority wants to keep nominal income at its equilibrium level $c = 0$, the union sets the wage - so as to minimize its expected loss from [4] under the condition of [7] - at

¹ For a recent survey see e.g. Argy [1991].

$$[8a] \quad \bar{w}_t^N = \frac{\alpha\beta(1+\delta)}{\beta+\delta^2}$$

where superscript N denotes nominal income targeting.

A comparison of [6a] and [8a] already shows that nominal wage claims under both rules are only identical if $\tau = 1$. This reflects that the slope of both aggregate demand curves (see [5] and [7]) are identical if $\tau = 1$. Empirical results, however, suggest that under a money supply rule the absolute value of the price elasticity of aggregate demand is in the short run smaller than 1 ($\tau < 1$) [see e.g. Taylor, 1985]. This implies that wage formation, measured in nominal terms, appears to be more aggressive under a money supply rule than under a nominal income rule, if the union places some weight on the real wage target.

Under a nominal income rule the resulting price level, real wage and output are:

$$[8b] \quad P_t^N = \frac{\alpha\beta\delta}{\beta+\delta^2} - \frac{1}{1+\delta} u_t$$

$$[8c] \quad \bar{w}_t^N - P_t^N = \frac{\alpha\beta}{\beta+\delta^2} + \frac{1}{1+\delta} u_t$$

$$[8d] \quad Y_t^N = \frac{-\alpha\beta\delta}{\beta+\delta^2} + \frac{1}{1+\delta} u_t$$

As is known, a perfect nominal income rule fully absorbs all demand shocks. Furthermore, if $\beta > 0$, and in the absence of shocks the inflation rate under a nominal income rule [8b] is lower than under a money supply rule [6b] under the assumption of $\tau < 1$. However, the real wage increase and the income loss are identical in both regimes. Although a nominal income rule does not prevent real income from dropping in the absence of shocks, inflation, in general, will differ if the union is aggressive.

Price Level (Inflation Rate) Targeting

Now, the above results will be compared to the case where the monetary authority targets the price level (or inflation rate) directly. Again, it is assumed that the authority can target the inflation rate accurately, which, in fact, implies that money supply changes transmit quickly and foreseeably into price level changes.

If the monetary authority follows a strict price rule, the nominal wage which minimizes the expected loss from [4] is given by:

$$[9a] \quad \bar{w}_t^P = \frac{\alpha\beta}{\beta+\delta^2}$$

where superscript P denotes a price rule. Obviously, nominal wage demands are lower under a rigid price rule than under nominal income targeting or a constant money supply rule. Since monetary policy adjusts money supply so as to keep the price level constant

$$[9b] \quad p_t^P = 0$$

the resulting real wage and output are:

$$[9c] \quad \bar{w}_t^P - p_t^P = \frac{\alpha\beta}{\beta+\delta^2}$$

$$[9d] \quad Y_t^P = \frac{-\alpha\beta\delta}{\beta+\delta^2} + u_t$$

Independent of the size of shocks the union can reach its (ex ante) preferred real wage. Meanwhile, a supply shock is fully transmitted to real economic activity.

To compare the effects of the alternative regimes completely the expected losses for the union and the authority are calculated respectively.

Expected Losses

The expected loss of the union at the end of $t-1$ for period t [$E_{t-1}L_t^U$] under the 3 alternative regimes is calculated by substituting the results under each rule [6c-d, 8c-d, 9c-d] into the union's loss function [1] and taking expectations. One obtains:

$$[10] E_{t-1}L_t^{UM} = \frac{\beta\alpha^2\delta^2}{\beta+\delta^2} + \frac{1}{(\delta+\tau)^2} [(\beta+\delta^2)\sigma_v^2 + (\beta+\tau^2)\sigma_u^2]$$

$$[11] E_{t-1}L_t^{UN} = \frac{\beta\alpha^2\delta^2}{\beta+\delta^2} + \frac{1+\beta}{(1+\delta)^2} \cdot \sigma_u^2$$

$$[12] E_{t-1}L_t^{UP} = \frac{\beta\alpha^2\delta^2}{\beta+\delta^2} + \sigma_u^2,$$

where [10] describes the expected loss of the union under a constant money rule, [11] the expected loss of the union under a nominal income rule and [12] the expected loss of the union under a price rule. Comparing [10], [11] and [12] reveals, that the preferred regime on part of the union depends only on the size of the shocks. In the absence of shocks ($\sigma_u^2 = \sigma_v^2 = 0$), the loss of the union is identical under all three regimes. When demand shocks are large, a nominal income or a price rule is preferable to the union. In the case of supply shocks, the choice between a nominal income and price rule depends on how big the effect of surprise inflation (δ) is, and how much weight β is placed on the real wage target. Thus, if $\beta > \delta(2+\delta)$, the union would prefer a price level (inflation) target to a nominal income target.

The equivalent expected losses under all three regimes for the authority after wages are set are calculated in the same manner. Substituting [6c-d, 8c-d, 9c-d] in the authority's loss function [2] and taking expectations yields:

$$[13] \quad E_{t-1}L_t^{AM} = \frac{(\Phi+\tau^2)(\alpha\beta\delta)^2}{[\tau(\beta+\delta^2)]^2} + \frac{1}{(\delta+\tau)^2} [(\delta^2+\Phi)\sigma_v^2 + (\Phi+\tau^2)\sigma_u^2]$$

$$[14] \quad E_{t-1}L_t^{AN} = \frac{(\Phi+1)(\alpha\beta\delta)^2}{(\beta+\delta^2)^2} + \frac{1+\Phi}{(1+\delta)^2} \sigma_u^2$$

$$[15] \quad E_{t-1}L_t^{AP} = \frac{(\alpha\beta\delta)^2}{(\beta+\delta^2)^2} + \sigma_u^2$$

Equation [13] gives the expected loss of the authority under a constant money rule, [14] the expected loss of the authority under a nominal income rule, and [15] the expected loss of the authority under a price rule. Obviously, as long as there are no shocks in the economy and the union is cooperative ($\beta = 0$) the regime does not make a difference; the authority can reach both targets - price stability and full employment - completely. In the event of shocks, the usual stabilization properties hold. A nominal income rule or a price rule fully absorbs demand shocks.

However if $\beta > 0$ results differ significantly. In the absence of shocks and under the assumption that $\tau < 1$, the authority would prefer a price rule to a nominal income rule or a money supply rule, because

$$[16] \quad E_{t-1}L_t^{AP} < E_{t-1}L_t^{AN} < E_{t-1}L_t^{AM} \quad \text{for } \tau < 1, \sigma_v^2 = \sigma_u^2 = 0.$$

Thus, in the absence of supply shocks, the authority would prefer the outcome of a rigid price rule.¹ The reason is, that under a price rule the authority varies the money supply in such a way that a strong union reaches its real wage target with zero price inflation, thereby avoiding the inflationary effect of higher nominal wage demands under a nominal income or money supply rule.

¹ The above results may be interpreted as an appraisal of a "supply shock adjusted price rule".

Still, none of these rules can prevent real income from falling below the natural rate as long as the labor union is strong and places some weight on its real wage target.

The intuition behind the results is obvious. Under the assumption that strong unions do not care about inflation itself, the authority is precommitted to a certain rule, and in the absence of shocks a strong union can select its preferred real wage - unemployment combination. The union will demand whatever nominal wage is necessary to reach its preferred combination. Due to different reaction functions of the authority under alternative regimes the resulting price level (inflation rate) will differ.

From an analytical point of view, a nominal wage increase above the rate which is ex ante consistent with full employment and price stability can be interpreted as a supply shock. From the aggregate supply equation [3] can be seen that under a price rule, an increase in wages has effects identical to a supply shock of the size $(-\delta\bar{w}_t)$. This illustrates the similarity between high wage demands and supply shocks. However, the nominal size of the "wage-supply-shock" depends on the trade union's loss function and on the policy regime.

4. The Importance of the Trade Union's Loss Function

In the above analysis, the trade union was assumed to be unconcerned about the inflation rate. Although economists have not come up with convincing arguments, as to why anticipated inflation should have much direct weight in the context of a rational expectation model, it might be argued that trade unions do care about inflation to some extent. For an economy as a whole, the costs of inflation include administrative costs of posting new prices as well as the so-called "shoe leather costs of inflation". A union might prefer a specific unemployment real wage combination at low inflation rates to an identical macroeconomic

result with higher inflation, because unemployed labor would in the former case be better off, as long as unemployment benefits are not fully indexed to current inflation. Thus, as long as unions care about their "unemployed members" to at least some degree, the inflation rate itself may have some weight in the union's objective function. (However, the following modification does not depend on the union's weight assigned to inflation being particularly large.)

The union's loss function [1] is changed to [1'], where ϵ represents the additional weight assigned to the inflation target.

$$[1'] \quad L_t^u = \beta [\bar{w}_t - p_t - \alpha]^2 + Y_t^2 + \epsilon p_t^2$$

Now the union sets the wage as to minimize the expected loss from [1'] under the condition that the authority follows a money supply, nominal income or price rule. Under a money supply rule we obtain:

$$[6a'] \quad \bar{w}_t^M = \frac{\alpha\beta\tau(\delta+\tau)}{\tau^2(\beta+\delta^2)+\epsilon\delta^2}$$

$$[6b'] \quad p_t^M = \frac{\alpha\beta\delta\tau}{\tau^2(\beta+\delta^2)+\epsilon\delta^2} + \frac{1}{\delta+\tau} [v_t - u_t]$$

$$[6c'] \quad \bar{w}_t^M - p_t^M = \frac{\alpha\beta\tau^2}{\tau^2(\beta+\delta^2)+\epsilon\delta^2} + \frac{1}{\delta+\tau} [u_t - v_t]$$

$$[6d'] \quad Y_t^M = \frac{-\alpha\beta\delta\tau^2}{\tau^2(\beta+\delta^2)+\epsilon\delta^2} + \frac{1}{\delta+\tau} [\delta v_t + \tau u_t]$$

Under a nominal income rule we get:

$$[8a'] \quad \bar{w}_t^N = \frac{\alpha\beta(1+\delta)}{\beta+(1+\epsilon)\delta^2}$$

$$[8b'] \quad p_t^N = \frac{\alpha\beta\delta}{\beta+(1+\epsilon)\delta^2} - \frac{1}{1+\delta} u_t$$

$$[8c'] \quad \bar{w}_t^N - p_t^N = \frac{\alpha\beta}{\beta+(1+\epsilon)\delta^2} + \frac{1}{1+\delta} u_t$$

$$[8d'] \quad y_t^N = \frac{-\alpha\beta\delta}{\beta+(1+\epsilon)\delta^2} + \frac{1}{1+\delta} u_t$$

Under a price rule results [9a-d], as well as the expected losses, (12,15) remain the same. The respective expected losses under a money supply and nominal income rule for the trade union are:

$$[10'] \quad E_{t-1}^{L_t^{UM}} = \frac{\beta\alpha^2\delta^2(\tau^2+\epsilon)}{\tau^2(\beta+\delta^2)+\epsilon\delta^2} + \frac{1}{(\delta+\tau)^2} [(\beta+\delta^2+\epsilon)\sigma_v^2 + (\beta+\tau^2+\epsilon)\sigma_u^2]$$

$$[11'] \quad E_{t-1}^{L_t^{UN}} = \frac{\beta\alpha^2\delta^2(1+\epsilon)}{\beta+(1+\epsilon)\delta^2} + \frac{\beta+\epsilon+1}{(1+\delta)^2} \cdot \sigma_u^2$$

The equivalent expected losses for the authority are

$$[13'] \quad E_{t-1}^{L_t^{AM}} = \frac{(\phi+\tau^2)(\alpha\beta\delta\tau)^2}{[\tau^2(\beta+\delta^2)+\epsilon\delta^2]^2} + \frac{1}{(\delta+\tau)^2} [(\phi+\delta^2)\sigma_v^2 + (\phi+\tau^2)\sigma_u^2]$$

$$[14'] \quad E_{t-1}^{L_t^{AN}} = \frac{(\phi+1)(\alpha\beta\delta)^2}{[\beta+(1+\epsilon)\delta^2]^2} + \frac{1+\phi}{(1+\delta)^2} \sigma_u^2$$

Shocks influence the real wage, the price level, real income, and the expected losses of the authority just as before. However, as long as the trade union assigns at least some weight to inflation, not only nominal variables, but also real wage and real income differ under alternative regimes.

If the authority follows a strict price rule, the trade union's weight assigned to the inflation objective does not alter the overall outcome. However, if the authority follows either a constant money supply or nominal income rule, and the union

assigns some weight to inflation nominal wage demands, real wage and the loss in income will be lower. Furthermore, a comparison of [13'], [14'] and [15] reveals that it might be suboptimal for the authority to follow a strict price rule if the union itself cares about inflation.

5. Conclusions

The optimal nominal anchor depends on the wage negotiation behavior of trade unions and, vice versa, the wage formation process is influenced by the choice of the monetary policy rule. As long as trade unions are cooperative and no stocks occur, the government can reach its macroeconomic targets: full employment and price stability. This is true for a money supply rule and a nominal income rule, as well as a price level (inflation) rule.

Obviously, in the presence of disturbances the conventional shock stabilization properties hold. A rigid nominal income target, as well as a rigid price rule, fully absorb demand shocks. In the case of a negative supply shock, a nominal income rule divides the shock into a fall in output and an increase in the price level (almost) equiproportionally. In comparison, a price rule fully transmits the shock to real economic activity (employment).

However, if trade unions become aggressive, which is defined as assigning some weight to a real wage target above the level which is compatible with full employment, a money supply rule has a nominal wage inflation bias under certain plausible assumptions. Although this inflationary bias can be reduced by changing the rules of the game, none of the alternative anchors - nominal GNP or prices - can prevent real income from dropping. High nominal wage agreements by aggressive unions have effects similar to exogenous supply shocks, such as oil price increases. Yet, the nominal size of the "wage-shock" crucially depends on the specific monetary rule followed by the authorities.

In order to focus on the main message - the interdependence of trade unions' behavior and monetary policy rules - it seemed appropriate to choose a rather simple framework. In particular, this analysis was restricted to the consideration of rigid rules, which are by no means easy to implement. The alternative of a fully discretionary regime and reputational factors that can play a major role in multiperiod settings [e.g. Barro and Gordon, 1983b] were not explicitly considered.¹ In the one period framework presented here, discretion would dominate the alternative rules under certain assumptions.²

Last but not least, it has to be mentioned that a crucial assumption in the above analysis is that the union's weight assigned to the real wage objective is invariant with respect to the policy regime. However, in reality, it may not be excluded that the weight β changes under alternative policies, because the perception of the wage-unemployment trade-off between alternative regimes may differ. Nevertheless, the main point of this paper, that the optimal monetary policy rule depends on the wage negotiation behavior of labor unions and vice versa, that the choice of a specific monetary policy rule influences the wage formation process, should extend to a more sophisticated setting.

¹ In a multiperiod setting the change over time in the union's aggressivity would be of crucial importance.

² The benefits of being able to react flexibly to exogenous shocks have to outweigh the costs of the nominal wage inflation bias of a discretionary policy. See e.g. Frankel and Chinn [1991] for a comparison between rules and discretion in a structural framework where trade unions are (implicitly) fully cooperative.

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